TUBEWELLS

Where soil conditions permit, the tubewells described here will, if they have the necessary casing, provide pure water. They are much easier to install and cost much less than large diameter wells.

Tubewells will probably work well where simple earth borers or earth augers work (i.e., alluvial plains with few rocks in the soil), and where there is a permeable water-bearing layer 15 to 25 meters (50 to 80 feet) below the surface. They are sealed wells, and consequently sanitary, which offer no hazard to small children.
The small amounts of materials needed keep the cost down. These wells may not yield enough water for a lane group, but they would be big enough for a family of a small group of families.

The storage capacity in small diameter wells is small. Their yield depends largely on the rate at which water flows from the surrounding soil into the well. From a saturated sand layer, the flow is rapid. Water flowing in quickly replaces water drawn from the well. A well that taps such a layer seldom goes dry. But even when water-bearing sand is not reached, a well with even a limited storage capacity may yield enough water for a household.

Well Casing and Platforms

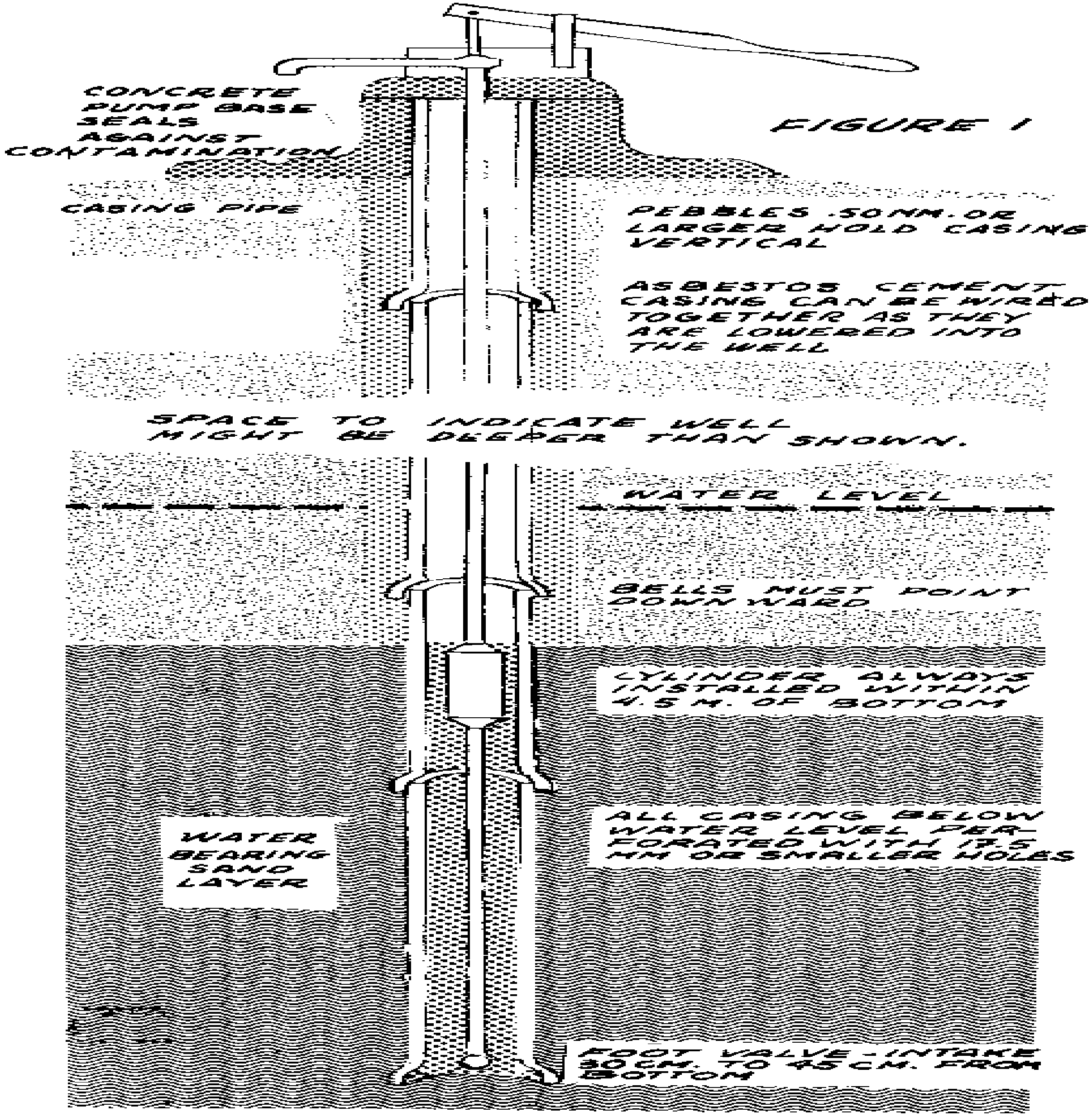
In home or village wells, casing and platforms serve two purposes: (1) to keep

well sides from caving in, and (2) to seal the well and keep any polluted surface water from entering it.

Two low-cost casing techniques are described here:

1. Method A (see Figure 1), from an American Friends Service Committee (AFSC)

fig1pg13.gif (600x600)



team in Rasulia, Madhya Pradesh, India.

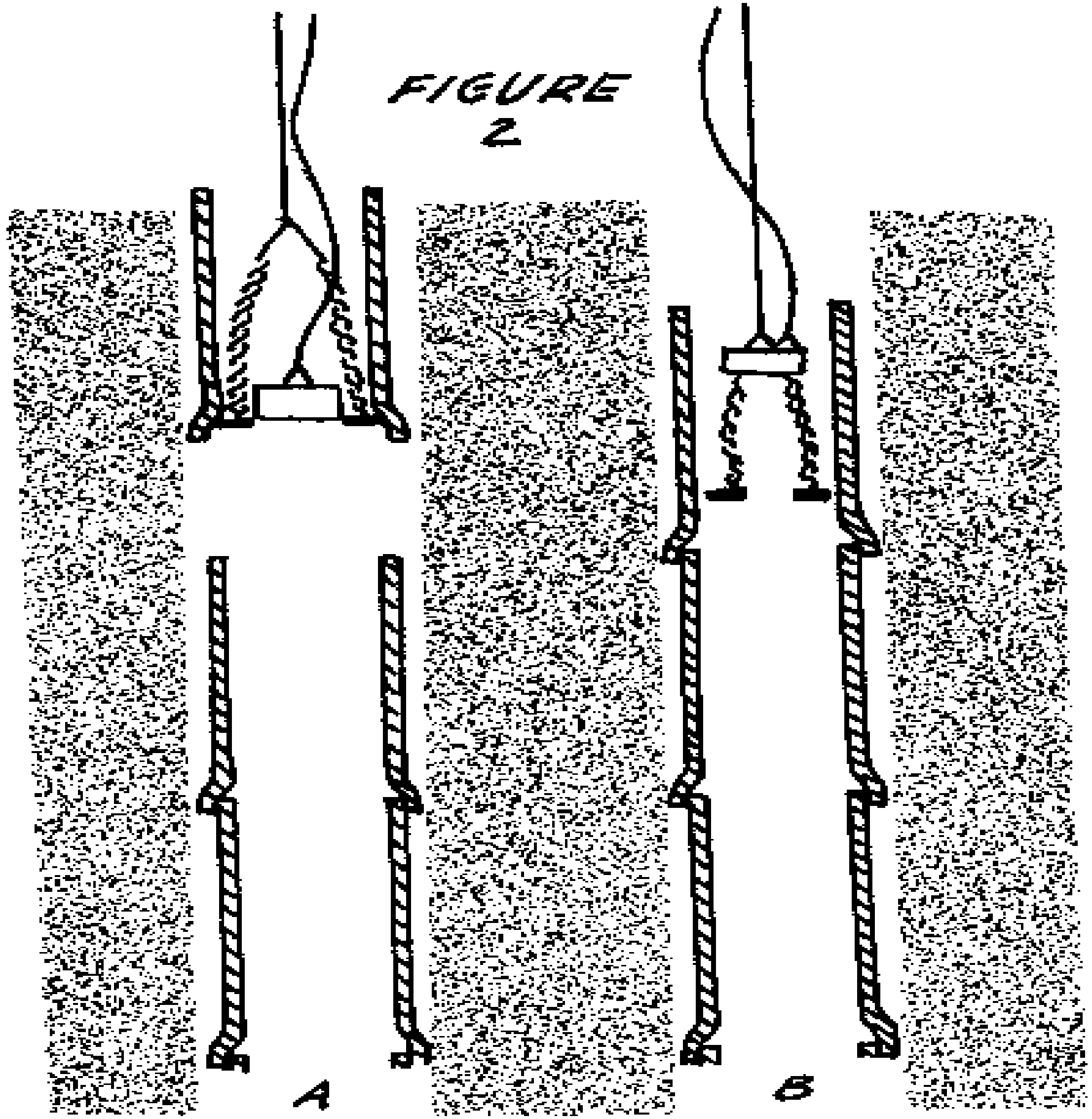
2. Method B, from an International Voluntary Services (IVS) team in Vietnam.

Method A

Tools and Materials

Casing pipe (from pump to water-bearing layer to below minimum water table)-
Asbestos
cement, tile, concrete, or even galvanized iron pipe will do
Sand
Gravel
Cement
Device for lowering and placing casing (see Figure 2)

fig2pg14.gif (540x540)



Drilling rig - see "Tubewell Boring"
Foot valve, cylinder, pipe, hand pump
The well hole is dug as deep as possible into the water-bearing strata. The diggings are placed near

the hole to make a mound, which later will serve to drain spilled water away from the well. This is important because backwash is one of the few sources of contamination for this type of well. The entire casing pipe below water level should be perforated with many small holes no larger than 5mm (3/16") in diameter. Holes larger than this will allow coarse sand to be washed inside and plug up the well. Fine particles of sand, however, are expected to enter. These should be small enough to be pumped immediately out through the pump. This keeps the well clear. The first water from the new well may bring with it large quantities of fine sand. When this happens, the first strokes should be strong and steady and continued until the water comes clear.

Perforated casing is lowered, bell end downward, into the hole using the device shown in Figure 2. When the casing is properly positioned, the trip cord is pulled and the next

section prepared and lowered. Since holes are easily drilled in asbestos cement pipe, they can be wired together at the joint and lowered into the well. Be sure the bells point downward, since this will prevent surface water or backwash from entering the well without the purifying filtration effect of the soil; it will also keep sand and dirt from filling the well. Install the casing vertically and fill the remaining space with pebbles. This will hold the casing plumb. The casing should rise 30 to 60cm (1' to 2') above ground level and be surrounded with a concrete pedestal to hold the pump and to drain spilled water away from the hole. Casing joints within 3 meters (10 feet) of the surface should be sealed with concrete or bituminous material.

Method B

Plastic seems to be an ideal casing material, but because it was not readily available, the galvanized iron and concrete casings described here were developed

in the Ban Me Thuot area of Vietnam.

Tools and Materials

Wooden V-block, 230cm (7 1/2') long (see Figure 3)

fig3pg15.gif (145x437)

Angle iron, 2 sections, 230cm (7 1/2') long
Pipe, 10cm (4") in diameter, 230cm (7 1/2') long
Clamps
Wooden mallet
Soldering equipment
Galvanized sheet metal: 0.4mm x 1m x 2m (0.01.6" x 39 1/2" x 79")

Plastic Casing

Black plastic pipe for sewers and drains was almost ideal. Its friction joints could
be quickly slipped together and sealed with a chemical solvent. It seemed durable
but was light enough to be lowered into the well by hand. It could be easily

sawed or drilled to make a screen. Care must be taken to be sure that any plastic used is non-toxic.

Galvanized Sheet Metal Casing

Galvanized sheet metal was used to make casing similar to downspouting. A thicker gauge than the 0.4mm (0.016") available would have been preferable. Because the sheet metal would not last indefinitely if used by itself, the well hole was made oversize and the ring-shaped space around the casing was filled with a thin concrete mixture which formed a cast concrete casing and seal outside the sheet metal when it hardened.

The 1-meter x 2-meter (39 1/2" x 79") sheets were cut lengthwise into three equal pieces, which yielded three 2-meter (79") lengths of 10cm (4") diameter pipe.

The edges were prepared for making seams by clamping them between the two angle irons, then pounding with a wooden mallet to the shape shown in Figure 3.

The seam is made slightly wider at one end than at the other to give the pipe a slight taper, which allows successive lengths to be slipped a short distance inside one another.

The strips are rolled by bridging them over a 2-meter (79") V-shaped wooden block and applying pressure from above with a length of 5cm (2") pipe (see

Figure 4).

fig4pg15.gif (393x393)

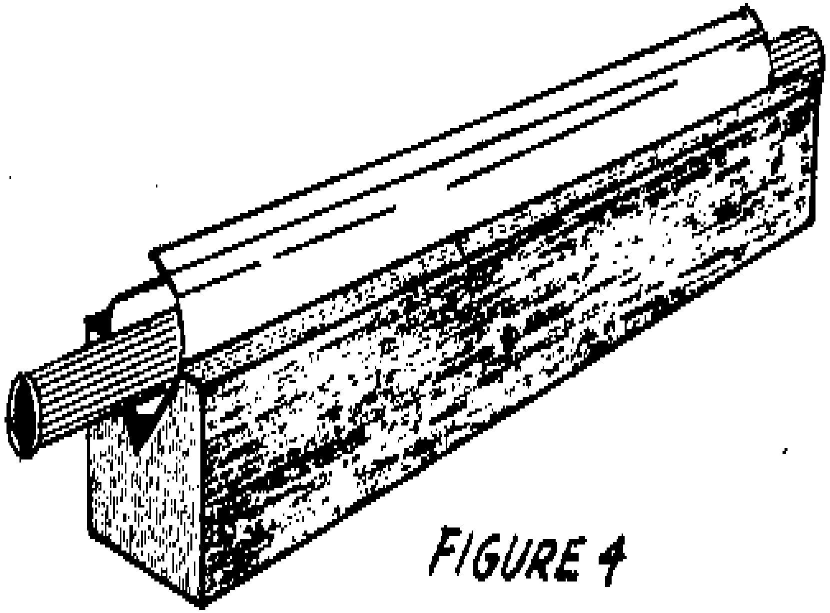


FIGURE 4

The sheet metal strips are shifted from side to side over the V-block as they are being bent to produce as uniform a surface as possible. When the strip is bent
enough, the two edges are hooked
together and the 5cm (2") pipe is slipped
inside. The ends of the pipe are set up
on wooden blocks to form an anvil, and
the seam is firmly crimped as shown in

Figure 5.

fig5pg15.gif (285x285)

After the seam is finished, any irregularities in the pipe are removed by applying pressure by hand or with the wooden mallet and pipe anvil. A local tinsmith and his helper were able to make six to eight lengths (12 to 16 meters) of the pipe per day. Three lengths of pipe were slipped together and soldered as they were made, and the remaining joints had to be soldered as the casing was lowered into the well.

The lower end of the pipe was perforated with a hand drill to form a screen.

After the casing was lowered to the bottom of the well, fine gravel was packed around the perforated portion of the casing to above the water level.
The cement grouting mortar used around the casings varied from pure cement to a 1:1 1/2 cement : sand ratio mixed with water to a very plastic consistency. The grout was put around the casing by gravity and a strip of bamboo about 10 meters (33 feet) long was used to "rod" the grout into place. A comparison of volume around the casing and volume of grouting used indicated that there may have been some voids left probably below the reach of the bamboo rod. These are not serious however, as long as a good seal is obtained for the first 8 to 10 meters (26 to 33 feet) down from the surface. In general, the greater proportion of cement used and the greater the space around the casing, the better seemed to be the results obtained. However, insufficient experience has been obtained to reach any final conclusions. In addition, economic considerations limit both of these factors.

Care must be taken in pouring the grout. If the sections of casing are not assembled perfectly straight, the casing, as a result, is not centered in the well
and the pressure of the grouting is not equal all the way around. The casing may collapse. With reasonable care, pouring the grout in several stages and allowing it
to set in-between should eliminate this. The grouting, however, cannot be poured in too many stages because a considerable amount sticks to the sides of the well each time, reducing the space for successive pourings to pass through.

This method can be modified for use in areas where the structure of the material through which the well is drilled is such that there is little or no danger of cave-in. In this situation, the casing serves only one purpose, as a sanitary seal.

The well will be cased only about 8 meters (26 feet) down from the ground surface. To do this, the well is drilled to the desired depth with a diameter roughly the same as that of the casing. The well is then reamed out to a diameter 5 to 6cm (2" to 2 1/4") larger than the casing down to the depth the casing will go. A flange fitted at the bottom of the casing with an outside diameter about equal to that of the reamed hole will center the casing in the hole and support the casing on the shoulder where the reaming stopped. Grouting is then poured as in the original method. This modification (1) saves considerable costly material, (2) allows the well to be made a smaller diameter except near the top, (3) lessens grouting difficulties, and (4) still provides adequate protection against pollution.

Concrete Tile Casing

If the well is enlarged to an adequate diameter, precast concrete tile with suitable joints could be used as casing. This would require a device for lowering the tiles into the well one by one and releasing them at the bottom. Mortar would have to be used to seal the joints above the water level, the mortar being spread on each successive joint before it is lowered. Asbestos cement casing would also be a possibility where it was available with suitable joints.

No Casing

The last possibility would be to use no casing at all. It is felt that when finances or skills do not permit the well to be cased, there are certain circumstances under which an uncased well would be better than no well at all. This is particularly true in localities where the custom is to boil or make tea out of all water before drinking it, where sanitation is greatly hampered by insufficient water supply, and where small-scale hand irrigation from wells can greatly improve the diet by making gardens possible in the dry season.

The danger of pollution in an uncased well can be minimized by: (1) choosing a favorable site for the well and (2) making a platform with a drain that leads away from the well, eliminating all spilled water.

Such a well should be tested frequently for pollution. If it is found unsafe, a notice to this effect should be posted conspicuously near the well.

Well Platform

In the work in the Ban Me Thuot area, a flat 1.75-meter (5.7') square slab of concrete was used around each well. However, under village conditions, this did not work well. Large quantities of water were spilled, in part due to the enthusiasm of the villagers for having a plentiful water supply, and the areas around wells became quite muddy.

The conclusion was reached that the only really satisfactory platform would be a round, slightly convex one with a small gutter around the outer edge. The gutter should lead to a concreted drain that would take the water a considerable distance from the well. It is worth noting that in Sudan and other very arid areas such spillage from community wells is used to water vegetable gardens or community nurseries.

If the well platform is too big and smooth, there is a great temptation on the part of the villagers to do their laundry and other washing around the well. This should be discouraged. In villages where animals run loose it is necessary to build a small fence around the well to keep out animals, especially poultry and pigs, which are very eager to get water, but tend to mess up the surroundings.

Sources:

Koegel, Richard G. Report. Ban Me Thuot, Vietnam: International Voluntary Services, 1959. (Mimeographed.)

Mott, Wendell. Explanatory Notes on Tubewells. Philadelphia: American Friends Service Committee, 1956. (Mimeographed.)

Hand-Operated Drilling Equipment

Two methods of drilling a shallow tubewell with hand-operated equipment are described here: Method A, which was used by an American Friends Service Committee (AFSC) team in India, operates by turning an earth-boring auger. Method B, developed by an International Voluntary Services (IVS) team in Vietnam, uses a ramming action.

Earth Boring Auger